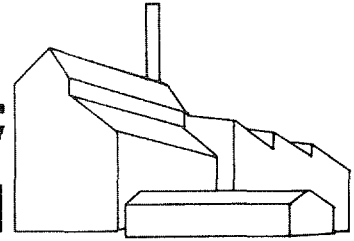


INDUSTRIAL ENERGY CONSUMPTION



Survey of Large Combustors:

Report on Alternative -Fuel Burning Capabilities of Large Boilers in 1979

U.S. Department of Energy
Energy Information Administration
Office of Energy Markets and End Use
Energy End Use Division

Introduction

During recent years, total annual industrial energy consumption in the United States has been approximated at 25 to 26 quadrillion British thermal units (Btu).¹ Manufacturing is by far the largest component, totaling 12.9 quadrillion Btu of purchased fuels and electricity for heat and power during 1979.² Of this amount, 10.5 quadrillion Btu was accounted for by purchased fuels alone (e.g., fuel oil, coal, natural gas, etc.).

Other than fuel consumption by type and industrial classification, very little information existed on specific fuel consumption characteristics of this important sector of the economy. For example, the role of non-purchased fuels such as waste gases was largely unknown as was specific information on ages and types of large combustors and alternative-fuel burning capabilities.

In order to provide some of this missing information, the Energy Information Administration (EIA) of the U.S. Department of Energy designed the 1980 Manufacturing Industries Energy Consumption Study and Survey of Large Combustors (EIA-463).³ This study concentrated on large combustors in the manufacturing industries. These "combustors" were defined as boilers, combined cycle units, gas turbines, or internal combustion engines with a maximum design firing rate of 50 million or more Btu per hour. This particular concentration was selected because it was felt that these combustors would account for the majority of the consumption of purchased and nonpurchased fuels in the manufacturing sector. In fact, the results of this survey (subject to the limitations of the study,

¹The industrial sector includes manufacturing, mining, construction, and agriculture. Total energy consumption is approximated from publications of the U.S. Departments of Agriculture and Commerce and includes feedstocks and byproduct fuels.

²U.S. Department of Commerce, Bureau of the Census. 1979 Annual Survey of Manufactures, Fuels and Electric Energy Consumed. Publication No. M79(AS)-4.1.

³Westat, Inc. of Rockville, Maryland administered the survey.

see next section) indicate that approximately 40 percent of the purchased fuels consumed by manufacturing are used to fire large industrial boilers.¹ This report presents initial findings of the alternative-fuel burning capabilities of these boilers during 1979.

CONTACTS

The following information is provided in case questions arise concerning this report:

This report was prepared in the Office of Energy Markets and End Use under the directorship of Wray Smith (252-8544). Overall direct report supervision was provided by Kenneth A. Vagts (252-1112), Director of the Energy End Use Division, and by Lynda T. Carlson (252-1116), Acting Chief of the Residential and Commercial Branch and Team Leader for all energy consumption data collections.

The report's principal author was John L. Preston (252-1124).

Major contributions to the survey were made by Stephen Dienstfrey (252-1128), John Mackens (252-1132), and Dwight French (252-1126)

¹The total number of combustors reported by responding establishments was 7,680. Of these 6,647 (87 percent) were classified as large boilers and actually burned a fuel of interest during 1979.

Background and Limitations of the Study¹

This survey was originally designed to collect data on all large combustors in the manufacturing industries and the establishments which operated them in 1979. The survey was mailed in November and December 1980 to a mailing list of 12,369 establishments judged most likely to operate combustors of interest. This list was subsequently reduced to a final survey frame of 10,456 through the deletion of 1,913 establishments which were determined to be out-of-scope,² out-of-business,³ not in the United States, or duplicate listings which were unidentifiable prior to mailing. By February 20, 1981, responses were received from 7,983 of these establishments (76 percent of the final survey frame). On that date, the Department of Energy received notification from the Office of Management and Budget that the authority for conducting the survey had been withdrawn. As a result, the EIA terminated the data collection effort and made no further contact with either respondents or nonrespondents.

Termination of the survey raised the possibility of two types of errors: nonresponse error or bias due to systematic nonresponse tendencies of particular groups or types of establishments and respondent errors resulting from the misinterpretation of instructions and other problems. In order to minimize the impact of these two types of errors, the EIA developed a special weighting procedure to estimate fuel consumption for nonrespondents and an editing and error resolution procedure to correct respondent errors.

Possible nonresponse biases were identified through a comparison of the results of this survey with a previous survey of a similar nature.⁴ From this analysis, it was determined likely that establishments with large numbers of combustors as well as those establishments operating very large combustors (with a maximum design firing rate in the range of 250 to 500 million Btu per hour) were likely to be under-represented to a larger extent than other establishments.

¹This section presents only a brief overview of the identification of and adjustments for nonresponse bias and respondent errors. For a complete discussion, the reader is referred to "Methodological Report on the 1980 Manufacturing Industries Energy Consumption Study and Survey of Large Combustors (EIA-463)", Publication Number DOE/EIA-0306.

²Out-of-scope establishments consisted of those which were Government-owned, engaged primarily in nonmanufacturing activities, or under construction.

³Out-of-business establishments consisted of those which were unlocatable and presumed to be out-of-business and those returned and known to be out-of-business with no successor.

⁴Comparisons were made between the EIA-463 responding and nonresponding establishments and the Major Fuel-Burning Installation (MFBI) file developed by the U.S. Department of Energy. See the methodological report for the details and results of these comparisons.

In order to approximate full response levels and to ameliorate the effect of these nonresponse biases, ratio estimation techniques were developed to estimate the total annual consumption of purchased fuels by large combustors. Basically, this consisted of developing weights for fuel consumption based upon the ratio of the estimated number of large combustors for all establishments in the survey frame to the estimated number of large combustors for responding establishments.¹

The types of biases which had been identified would be most likely to occur in specific industrial groups. For example, the largest combustors as well as large numbers of combustors tend to be located in the heavy durable goods manufacturing industries and in many of the chemical industries. In order to achieve the highest degree of validity possible, the nonresponse weights were developed at either the three- or four-digit Standard Industrial Classification (SIC) level of detail. These weights were then multiplied by the appropriate fuel consumption figures for responding establishments to estimate total fuel consumption. The values of these weights ranged from 1.000 to 2.824.

This weighting procedure will, to some extent, compensate for the identified nonresponse biases. Inherent in this procedure, however, is the assumption that fuel-use patterns and other combustor characteristics are invariant with respect to respondents and nonrespondents. The validity of this assumption is not known, although it is likely that the stratification by SIC groupings resulted in some degree of homogeneity. In general, it is felt that this weighting procedure was moderately successful in correcting the identified nonresponse biases and that overall error introduced by this procedure is likely to be small. If it is assumed, for example, that all nonresponse estimates produced by this procedure are in error by as much as 25 percent, the overall error in total Btu consumption would be only 6.3 percent. Moreover, this overall error rate will likely prevail as long as the data are fairly highly aggregated. The reader should be aware, however, that other nonresponse biases may be present in the sample which were undetected and uncompensated for by this weighting procedure.

Given that follow-up of respondents was precluded, the data presented in this report have been edited to the maximum extent possible. It is felt that these editing procedures identified and corrected the most severe respondent errors. This report on alternative-fuel burning capabilities primarily utilized data from the section of the questionnaire dealing with

¹It was reasoned that the estimated number of large combustors would be fairly highly correlated with fuel consumption. It was subsequently estimated that these correlations ranged between 0.30 and 0.97 for homogeneous (with respect to product specialization) groups of industries. See the methodological report for details on the development and testing of the weighting methodology.

amounts of fuels consumed (Section II, Item 7) and the Btu content of these fuels (Section I, Items 8 and 9). Therefore, response error that affect data in this report were errors in reporting of quantities. Specifically, several establishments reported amounts of gaseous fuels in cubic feet rather than thousands of cubic feet (MCF) as requested on the survey form. This type of error was readily detectable by estimating the annual Btu consumption of the boiler in question based upon the product of the usual design firing rate (Section II, Item 10) and the hours used at this rate (Section II, Item 13) and dividing this into the actual total Btu consumed as calculated from fuel amounts (Section II, Item 7) and Btu content (Section I, Item 8 and 9). Ratios of approximately 1.0 would be expected from such a procedure. Large values of this ratio usually indicated that reported amounts were off by a given factor and these fuel amounts were appropriately adjusted.

By means of a range check, a few apparent errors were also discovered in the section of the questionnaire dealing with Btu contents of fuels. These apparent errors were corrected by replacing some respondent-reported heating content values with standard heating content values as published in the Monthly Energy Review.¹

¹These estimates are published annually. See, for example, U.S. Department of Energy, Energy Information Administration, Monthly Energy Review, December 1981, DOE/EIA-0035(81/12).

Summary of Findings¹

Respondents to this survey reported 6,647 large industrial boilers which were actually in operation during 1979 (See Table 1). These boilers consumed a total of 4,433.4 trillion Btu of purchased and nonpurchased fuels. Of this amount, 1,382.5 trillion Btu or 31 percent, was natural gas. Consumption of fuel oil, coal, pulping liquor, and waste gases was considerably smaller, ranging from 536.7 trillion Btu to 786.3 trillion Btu.

Alternative-fuel burning capabilities, as shown in Table 1, were reported for 4,598 of these boilers (70 percent); these consumed a total of 3,461.8 trillion Btu of fuel. Most of these boilers (3,683) had the capability of burning natural gas as one of the alternative-fuels. The most common alternative-fuel burning capability was natural gas and fuel oil (2,256 boilers). The second most common was natural gas, fuel oil, and one or more other fuels not including coal (685 boilers). Clearly, there is widespread capability to burn either natural gas or fuel oil in the respondents' reported boilers.

Among boilers with alternative-fuel burning capabilities, natural gas was the most widely used fuel in 1979. As shown in Table 1, for example, boilers which were designed or modified to burn either natural gas or fuel oil consumed a total of 835.2 trillion Btu of which 657.9 trillion Btu (79 percent) was attributed to natural gas and 177.3 trillion Btu to fuel oil.

The nonpurchased fuels used were primarily pulping liquor and waste gases and are byproducts of production processes. Where the boilers had the capability of burning nonpurchased fuels as an alternative-fuel, respondents to this survey indicated a fairly heavy actual use of these fuels. For example, where boilers had the capability of burning natural gas and one or both of these nonpurchased fuels, the total consumption of the nonpurchased fuels was 145.4 trillion Btu versus 82.7 trillion Btu of natural gas. The difference is even greater for boilers capable of burning fuel oil and nonpurchased fuels. These boilers consumed 94.5 trillion Btu of fuel oil and 435.9 trillion Btu of these nonpurchased fuels. Finally, for the group of boilers capable of burning natural gas, fuel oil, and one or both of the nonpurchased fuels, the nonpurchased fuels were still the most heavily used. They accounted for 446.5 trillion Btu versus 204.4 for natural gas and 100.6 for fuel oil.

Coal, as an alternative-fuel, followed a similar pattern to nonpurchased fuels. Where the capability existed to burn coal, natural gas, and fuel oil, fuel oil was the least used in terms of Btu consumption.

¹Unless otherwise noted, these findings are discussed with respect to respondent values unadjusted for nonresponse, i.e., Tables 1 and 3. This was done because of the frequent references to the numbers of boilers for which population estimates were not prepared.

The use of natural gas over fuel oil is even more clear in Table 3 which presents alternative-fuel burning capabilities from a slightly different perspective. This table excludes all boilers which were not designed or modified to burn either fuel oil and/or natural gas. The boilers included in this table could have burned other fuels as well, however. Fuel consumption in this table is classified into three designed or modified categories and each of these is subdivided into categories of fuels actually burned. Table 3 includes coal in the "other fuels" category for the purpose of examining "fuels actually burned." As shown in this table, 3,364 boilers were capable of burning either natural gas or fuel oil and possibly some other fuel. Among these boilers, natural gas was consumed over fuel oil by a margin of nearly 3 to 1.

In connection with the issue of natural gas deregulation, a recent study attempted to estimate the latent or "frustrated" demand for natural gas by industrial users.¹ Latent demand in this context apparently was defined as the demand for natural gas which potentially exists economically (i.e., due to price considerations) but which is being diverted to other markets, principally fuel oil, because of various restrictions.² Under decontrol, the study assumed that this frustrated demand would gradually be registered in the market. The latent demand for 1979 was estimated at 1,850 trillion Btu of natural gas and this figure was used to adjust natural gas demand curves for the analysis of the likely impacts of natural gas deregulation.

The data from this survey imply that the potential for latent or frustrated demand for natural gas by large boilers in the manufacturing sector was at most 445.5 trillion Btu. This is the weighted consumption (in Btu) of fuel oil consumed in boilers with alternative burning capabilities in both fuel oil and natural gas (see Table 4).

¹A Study of Alternatives to the Natural Gas Policy Act of 1978, Appendix B, Industrial Gas Demand, November 1981, U.S. Department of Energy, Office of Policy, Planning, and Analysis, Division of Energy Deregulation, pp. 6-8. Industrial users are defined as including agriculture, mining, and manufacturing.

²Supply restrictions include curtailments and hookup moratoria which deny potential users access to natural gas. Demand policies include supply security, load balancing, and geographical hookup restrictions which require users to modify their fuel choice.

Weighted fuel consumption from this survey accounts for 4,235.0 trillion Btu¹ or approximately 40 percent of the purchased fuels consumed by manufacturing. The purchased fuels which are unaccounted for by this survey therefore amount to approximately 6,300 trillion Btu. This consumption would be primarily for process heat and for firing small boilers (less than 50 million Btu per hour). Given that process heaters are typically not designed to use more than one fuel and that the fuel consumption of small boilers is likely to be quite small relative to other end uses, it is difficult to confirm an industrial latent demand for natural gas greater than 600 trillion Btu.²

¹Derived by subtracting pulping liquor and waste gases from total fuels consumed in Table 2.

²This survey collected data only on the manufacturing sector. Little opportunity exists, however, for latent natural gas demand in either the mining or the agricultural sectors. In agriculture, the overwhelming end-use for fuels is for powering farm vehicles and equipment, operations which do not lend themselves to the use of any fuels other than gasoline and diesel fuel. In the mining sector, the most commonly used fuel is already natural gas.

TABLE 1. UNWEIGHTED^a ESTIMATES OF FUELS CONSUMED IN LARGE BOILERS^b BY CATEGORIES OF FUELS DESIGNED OR MODIFIED TO BURN, 1979 (TRILLION BTU)

Categories of Fuel Designed or Modified to Burn	Number of Boilers	Total Fuels Consumed	Fuels Consumed					
			Natural Gas	Fuel Oil ^c	Coal ^d	Pulping Liquor	Waste Gases ^e	Misc. ^f
Natural Gas Only.....	527	289.9	289.9	-	-	-	-	-
Fuel Oil Only.....	699	242.1	-	242.1	-	-	-	-
Coal Only.....	602	303.0	-	-	303.0	-	-	-
Other Only.....	221	136.6	-	-	-	13.4	38.1	85.1
Natural Gas/Fuel Oil.....	2,256	835.2	657.9	177.3	-	-	-	-
Natural Gas/Coal.....	134	110.6	26.2	-	84.4	-	-	-
Natural Gas/Other.....	230	266.1	82.7	-	-	89.8	55.6	38.0
Fuel Oil/Coal.....	346	270.9	-	79.1	191.8	-	-	-
Fuel Oil/Other.....	358	611.1	-	94.5	-	338.7	97.2	80.7
Coal/Other.....	77	71.3	-	-	36.4	-	23.1	11.8
Natural Gas/Fuel Oil/Coal...	333	189.4	72.1	23.9	93.4	-	-	-
Natural Gas/Fuel Oil/Other..	685	825.9	204.4	100.6	-	218.0	228.5	74.4
Natural Gas/Coal/Other.....	45	83.9	15.3	-	29.4	-	37.7	1.5
Fuel Oil/Coal/Other.....	44	61.5	-	13.1	13.1	-	25.0	10.3
Natural Gas/Fuel Oil/Coal/ Other.....	90	135.9	34.0	19.4	34.8	-	31.5	16.1
TOTAL FUEL CONSUMED.....	6,647	4,433.4	1,382.5	750.0	786.3	659.9	536.7	317.9

^aData tabulated are taken from a survey in which 24 percent of the establishments are not accounted for.

^bMaximum design firing rate of 50 million Btu per hour or greater.

^cIncludes distillate fuel oils (1,2,4 and light diesel) and residual fuel oils (5,6 and heavy diesel).

^dIncludes anthracite, bituminous, and lignite.

^eIncludes blast furnace, coke oven, and refinery off-gases.

^fMiscellaneous. This includes coke and breeze; wood, bark, and wood waste; motor gasoline; and LPG, butane, and propane.

Note: Data may not sum to totals due to rounding. A dash "-" represents or rounds to zero.

Source: Energy End Use Division, Office of Energy Markets and End Use, Energy Information Administration, U.S. Department of Energy, "1980 Manufacturing Industries Energy Consumption Study and Survey of Large Combustors", (DOE/EIA-0306).

TABLE 2. WEIGHTED^a ESTIMATES OF FUELS CONSUMED IN LARGE BOILERS^b BY CATEGORIES OF FUELS DESIGNED OR MODIFIED TO BURN, 1979 (TRILLION BTU)

Categories of Fuel Designed or Modified to Burn	Total Fuels Consumed	Fuels Consumed					
		Natural Gas	Fuel Oil ^c	Coal ^d	Pulping Liquor	Waste Gases ^e	Misc. ^f
Natural Gas Only.....	391.8	391.8	-	-	-	-	-
Fuel Oil Only.....	305.5	-	305.5	-	-	-	-
Coal Only.....	401.7	-	-	401.7	-	-	-
Other Only.....	181.0	-	-	-	15.8	61.0	104.1
Natural Gas/Fuel Oil.....	1,066.7	844.6	222.1	-	-	-	-
Natural Gas/Coal.....	143.9	32.3	-	111.6	-	-	-
Natural Gas/Other.....	385.2	128.7	-	-	110.0	99.2	47.3
Fuel Oil/Coal.....	336.4	-	96.5	239.9	-	-	-
Fuel Oil/Other.....	782.6	-	130.8	-	410.9	146.3	94.7
Coal/Other.....	89.1	-	-	45.4	-	29.6	14.1
Natural Gas/Fuel Oil/Coal...	233.4	90.9	29.7	112.8	-	-	-
Natural Gas/Fuel Oil/Other..	1,198.1	301.4	158.2	-	262.3	387.4	88.9
Natural Gas/Coal/Other.....	101.4	18.0	-	36.4	-	45.1	1.8
Fuel Oil/Coal/Other.....	76.1	-	15.8	15.2	-	31.7	13.3
Natural Gas/Fuel Oil/Coal/ Other.....	181.8	45.5	35.4	40.5	-	40.4	20.0
TOTAL FUEL CONSUMED.....	5,874.7	1,853.2	994.0	1,003.5	799.0	840.7	384.2

^aData imputed to adjust for nonresponse contribute on average about 30 percent of the tabulated values. It is unclear as to whether the raw data constitute a probability sample of the universe of all large combustors.

^bMaximum design firing rate of 50 million Btu per hour or greater.

^cIncludes distillate fuel oils (1,2,4 and light diesel) and residual fuel oils (5,6 and heavy diesel).

^dIncludes anthracite, bituminous, and lignite.

^eIncludes blast furnace, coke oven, and refinery off-gases.

^fMiscellaneous. This includes coke and breeze; wood, bark, and wood waste; motor gasoline; and LPG, butane, and propane.

Note: Data may not sum to totals due to rounding. A dash "-" represents or rounds to zero.

Source: Energy End Use Division, Office of Energy Markets and End Use, Energy Information Administration, U.S. Department of Energy, "1980 Manufacturing Industries Energy Consumption Study and Survey of Large Combustors", (DOE/EIA-0306).

TABLE 3. UNWEIGHTED^a ESTIMATES OF FUEL CONSUMPTION IN LARGE BOILERS^b, DESIGNED TO BURN FUEL OIL OR NATURAL GAS OR BOTH, CLASSIFIED BY SELECTED ALTERNATE-FUEL BURNING CAPABILITY AND ACTUAL COMBINATION OF FUELS USED, 1979 (TRILLION BTU)

Selected Categories of Fuel Designed or Modified to Burn with Subcategories of Fuels Actually Burned	Number of Boilers	Total Fuels Consumed	Fuels Consumed					
			Natural Gas	Fuel Oil ^c	Other Fuels			
					Coal ^d	Pulping Liquor	Waste Gases ^e	Misc. ^f
Natural Gas But Not Fuel Oil.....	936	750.5	414.0	-	113.8	89.9	93.3	39.6
Used Natural Gas Only.....	566	308.0	308.0	-	-	-	-	-
Used Other Only.....	55	38.0	-	-	7.7	10.0	14.3	6.1
Used Natural Gas/Other.....	315	404.5	106.0	-	106.1	79.9	79.0	33.5
Natural Gas and Fuel Oil.....	3,364	1,986.3	968.5	321.3	128.2	218.0	260.1	90.4
Used Natural Gas Only.....	692	234.2	234.2	-	-	-	-	-
Used Fuel Oil Only.....	151	42.5	-	42.5	-	-	-	-
Used Other Only.....	44	34.6	-	-	5.3	12.4	16.3	0.6
Used Natural Gas/Fuel Oil.....	1,769	694.9	517.5	177.5	-	-	-	-
Used Natural Gas/Other.....	191	229.1	57.7	-	33.3	40.8	88.9	8.4
Used Fuel Oil/Other.....	63	75.0	-	10.1	39.6	6.7	13.5	5.1
Used Natural Gas/Fuel Oil/Other...	454	676.0	159.1	91.2	50.0	158.1	141.4	76.3
Fuel Oil But Not Natural Gas.....	1,447	1,185.5	-	428.6	204.8	338.7	122.6	91.0
Used Fuel Oil Only.....	905	325.5	-	325.5	-	-	-	-
Used Other Only.....	49	27.6	-	-	11.2	2.5	8.9	5.4
Used Fuel Oil/Other.....	493	832.4	-	103.1	193.6	336.2	113.7	85.6
TOTAL FUEL CONSUMED.....	5,747	3,922.3	1,382.5	749.9	446.8	646.6	476.0	221.0

^aData tabulated are taken from a sample survey in which 24 percent of the establishments are not accounted for.

^bMaximum design firing rate of 50 million Btu per hour or greater.

^cIncludes distillate fuel oils (1,2,4 and light diesel) and residual fuel oils (5,6 and heavy diesel).

^dIncludes anthracite, bituminous, and lignite.

^eIncludes blast furnace gas, coke oven gas, and refinery off-gases.

^fMiscellaneous. This includes coke and breeze; wood, bark, and wood waste; motor gasoline; and LPG, butane, and propane.

Note: Data may not sum to totals due to rounding. A dash "-" represents or rounds to zero.

Source: Energy End Use Division, Office of Energy Markets and End Use, Energy Information Administration, U.S. Department of Energy, "1980 Manufacturing Industries Energy Consumption Study and Survey of Large Combustors", (DOE/EIA-0306).

TABLE 4. WEIGHTED^a ESTIMATES OF FUEL CONSUMPTION IN LARGE BOILERS^b, DESIGNED TO BURN FUEL OIL OR NATURAL GAS OR BOTH, CLASSIFIED BY SELECTED ALTERNATE-FUEL BURNING CAPABILITY AND ACTUAL COMBINATION OF FUELS USED, 1979 (TRILLION BTU)

Selected Categories of Fuel Designed or Modified to Burn with Subcategories of Fuels Actually Burned	Total Fuels Consumed	Fuels Consumed					
		Natural Gas	Fuel Oil ^c	Coal ^d	Pulping Liquor	Waste Gases ^e	Misc. ^f
Natural Gas But Not Fuel Oil.....	1,022.1	570.7	-	148.0	110.0	144.4	49.1
Used Natural Gas Only.....	413.0	413.0	-	-	-	-	-
Used Other Only.....	58.6	-	-	10.6	12.3	28.0	7.8
Used Gas/Other.....	550.5	157.7	-	137.4	97.7	116.4	41.3
Natural Gas and Fuel Oil.....	2,680.2	1,282.5	445.5	153.4	262.3	427.8	108.8
Used Natural Gas Only.....	313.1	313.1	-	-	-	-	-
Used Fuel Oil Only.....	64.5	-	64.5	-	-	-	-
Used Other Only.....	60.5	-	-	6.0	15.7	38.0	0.8
Used Natural Gas/Fuel Oil.....	874.0	652.9	221.1	-	-	-	-
Used Gas/Other.....	348.1	92.4	-	37.9	50.8	156.5	10.5
Used Fuel Oil/Other.....	100.8	-	13.0	49.2	8.1	24.6	5.9
Used Natural Gas/Fuel Oil/Other....	919.2	224.1	146.9	60.3	187.7	208.7	91.6
Fuel Oil But Not Natural Gas.....	1,500.6	-	548.6	255.2	410.9	178.0	108.0
Used Fuel Oil Only.....	407.0	-	407.0	-	-	-	-
Used Other Only.....	37.0	-	-	16.3	3.5	10.4	6.9
Used Fuel Oil/Other.....	1,056.6	-	141.6	238.9	407.4	167.6	101.1
TOTAL FUEL CONSUMED.....	5,202.9	1,853.2	994.1	556.6	783.2	750.2	265.9

^aData imputed to adjust for nonresponse contribute on average about 30 percent of the tabulated values. It is unclear as to whether the raw data constitute a probability sample from the universe of all large combustors.

^bMaximum design firing rate of 50 million Btu per hour or greater.

^cIncludes distillate fuel oils (1,2,4 and light diesel) and residual fuel oils (5,6 and heavy diesel).

^dIncludes anthracite, bituminous, and lignite.

^eIncludes blast furnace gas, coke oven gas, and refinery off-gases.

^fMiscellaneous. This includes coke and breeze; wood, bark, and wood waste; motor gasoline; and LPG, butane, and propane.

Note: Data may not sum to totals due to rounding. A dash "-" represents or rounds to zero.

Source: Energy End Use Division, Office of Energy Markets and End Use, Energy Information Administration, U.S. Department of Energy, "1980 Manufacturing Industries Energy Consumption Study and Survey of Large Combustors", (DOE/EIA-0306).

UNITED STATES
DEPARTMENT OF ENERGY
ENERGY INFORMATION ADMINISTRATION

FORM APPROVED
OMB NUMBER 038-S80011



1980 Manufacturing Industries
Energy Consumption Study and
Survey of Large Combustors

This report is mandatory under the Federal Energy Administration Act of 1974, P.L. 93-275, and the Powerplant and Industrial Fuel Use Act of 1978, P.L. 95-620. Failure to respond may result in criminal fines, civil penalties and other sanctions, as provided by law.

The information reported on these forms may be (i) information that is exempt from disclosure to the public under the exemption for trade secrets and confidential commercial information specified in the Freedom of Information Act, 5 USC 552 (b) (4) (FOIA), or (ii) prohibited from public release by 18 USC 1905. However, before the determination can be made that particular information is within the coverage of either of these statutory provisions, the person submitting the information must make a showing, satisfactory to the Department of Energy, concerning its confidential nature.

Therefore, respondents wishing to claim such exemption must state specifically (on an element by element basis, if possible) in a letter accompanying submission of this form, why they consider the information concerned to be a trade secret or other proprietary information, whether such information is customarily treated as confidential information by these companies and the industry, and the type of competitive harm that would result from disclosure of the information. In accordance with the provisions of 10 CFR 1004.11, DOE's Freedom of Information Act Regulations, DOE will determine whether the information submitted should be withheld from public disclosure. If DOE receives the responses and does not receive a request with substantive justification that the information submitted should not be released to the public, DOE may assume that the respondent does not object to disclosure to the public of any information submitted by it on the forms.

The provisions of Section 711(a) of P.L. 95-620, the Powerplant and Industrial Fuel Use Act of 1978, which incorporate by reference the provisions of Section 11 (d) of P.L. 93-319, the Energy Supply and Environmental Coordination Act of 1974, apply to the information submitted on this form. Upon request, therefore, DOE must provide information obtained on this form to the Attorney General, the Secretary of the Interior, and the Federal Trade Commission in accordance with the cited statutes and other applicable authority. The information must also be made available upon request to the Congress or any committee of the Congress and to the General Accounting Office.

WHAT TO FILL OUT:

- Complete Section I (on yellow paper) only once; it applies to your establishment (shown on mail label below) as a whole.
- Complete a separate copy of Section II (on blue paper) for:
 - each boiler, gas turbine, and internal combustion engine with a maximum design firing rate of 50 million Btu/hr or greater, and
 - each fired component of a combined cycle unit in which the components total a firing rate of 50 million Btu/hr or greater.
- If your company did not operate this establishment at any time in 1979 answer only items 1 through 7, and 14 through 18 of Section I. Then complete Section II forms required.
- If your establishment **does not have** any boiler, gas turbine, internal combustion engine and/or combined cycle units with a maximum design firing rate of 50 million Btu/hr or greater, answer **only** items 1 through 7 and 15 through 18 of Section I.

SEE SECTION II, PAGE 4 FOR ADDITIONAL INSTRUCTIONS

SECTION I — ESTABLISHMENT (PLANT) REPORT

1. Name and physical location of establishment.

MAIL LABEL

NAME

NUMBER AND STREET

CITY, TOWN, VILLAGE, ETC.

COUNTY

STATE

ZIP

(Please correct any error in name and mail address on label, including zip code.)

ESTABLISHMENT IDENTIFICATION

- | | | | | | | | | | | | |
|--|--|---|--|--|--|--|--|--|--|--|--|
| | | - | | | | | | | | | |
|--|--|---|--|--|--|--|--|--|--|--|--|

- | | | | | |
|--|--|--|--|--|
| | | | | |
|--|--|--|--|--|

- THOU UNITS

NAME _____

NUMBER AND STREET

CITY

STATE

ZIP

- Months _____

- Specify month and year started: _____
MONTH YEAR

- Specify month and year in which acquired or leased: _____

MONTH
YEAR

NAME _____

NUMBER AND STREET

CITY

STATE

719

- Specify month and year in which sold or leased: _____
MONTH YEAR

NAME _____

NUMBER AND STREET

CITY

STATE

ZIP

- Specify month and year in which closed, etc.: _____
MONTH YEAR

FUEL CODES
(for office use only)

FUEL CONSUMPTION

8. Fill out the following table for fuels used by this establishment during calendar year 1979 for heat, power, and/or generation of electricity. Actual shipment of fuels may have occurred earlier than 1979.

- Fill out all portions that apply; leave others blank.
- Include:
 - purchased fuels.
 - non-purchased fuels, such as interplant transfers.
 - fuels mined or extracted onsite and **used** at the site.
- Do not include:
 - fuels produced as byproducts of onsite operations (these are to be reported in item 9).
 - fuels used for transportation equipment.
 - fuels used for feedstocks (see Glossary for "feedstocks").
- Note that the amount of "wood, bark, wood waste" is asked for on a "50 percent moisture" basis. Adjustments may be necessary in estimating the amount used.
- Figures for amounts in excess of 100,000 may be rounded to thousands; if you prefer, however, you may report exact amounts.

Example: If this establishment used 1,256,680 mcf of natural gas in 1979, report **either:**

MIL	THOU	UNITS		MIL	THOU	UNITS
1	256	680	or	1	257	000

FUEL	AMOUNT USED FOR HEAT, POWER AND/OR GENERATION OF ELECTRICITY			AVERAGE Btu CONTENT (HIGHER HEATING VALUE)		AVERAGE % SULFUR (BY WEIGHT)
	MIL	THOU	UNITS	THOU	UNITS	
SOLIDS						
(11) Anthracite			/ / / / / ton		per lb	%
(12) Bituminous coal (non-metallurgical uses)			/ / / / / ton		per lb	%
(13) Lignite			/ / / / / ton		per lb	%
(14) Coke and breeze			/ / / / / ton		per lb	%
(15) Wood, bark, wood waste (50% moisture basis)			/ / / / / ton		per lb	
Other solid fuels (specify)						
			/ / / / / ton		per lb	%
			/ / / / / ton		per lb	%
LIQUIDS						
(21) Motor gasoline (for stationary engines)			/ / / / / gal		per gal	
(22) Distillate fuel oils (1, 2, 4 & light diesel)			/ / / / / gal		per gal	%
(23) Residual fuel oils (5, 6 & heavy diesel)			/ / / / / gal		per gal	%
Other liquid fuels (specify)						
			/ / / / / gal		per gal	%
			/ / / / / gal		per gal	%
GASES						
(31) Natural gas			/ / / / / mcf		per cu ft	
(32) LPG, butane, propane			/ / / / / gal		per gal	
Other gaseous fuels (specify)						
			/ / / / / mcf		per cu ft	%
			/ / / / / mcf		per cu ft	%

FUEL CODES
(for office use only)

FUEL CONSUMPTION

9. Please fill out the following table for fuels which were produced onsite as byproducts of establishment operations during 1979.

- DO NOT INCLUDE any amounts of fuel reported in item 8.
- Note that "pulping liquor" is specified on a "bone-dry" basis; give the amount used in tons.
- Fill out all portions that apply; leave others blank.

☐ No fuels produced as byproducts in 1979 (go to item 10a & b)

FUEL	AMOUNT USED AT SITE FOR HEAT, POWER AND/OR GENERATION OF ELECTRICITY			AVERAGE Btu CONTENT (HIGHER HEATING VALUE)		AMOUNT SOLD OR TRANSFERRED OFFSITE			
	MIL	THOU	UNITS	THOU	UNITS	MIL	THOU	UNITS	
(14) Coke			<div></div>	ton				<div></div>	ton
(15) Wood, bark, wood waste (50% moisture basis)			<div></div>	ton				<div></div>	ton
(24) Pulping liquor (bone dry basis)			<div></div>	ton				<div></div>	ton
Other solid fuel (specify)			<div></div>	ton				<div></div>	ton
			<div></div>	ton				<div></div>	ton
Other liquid fuel (specify)			<div></div>	gal				<div></div>	gal
			<div></div>	gal				<div></div>	gal
PROCESS OFF GASES:									
(33) Blast furnace gas			<div></div>	mcf				<div></div>	mcf
(34) Coke oven gas			<div></div>	mcf				<div></div>	mcf
(35) Refinery off gas			<div></div>	mcf				<div></div>	mcf
Other process gases (specify)			<div></div>	mcf				<div></div>	mcf
			<div></div>	mcf				<div></div>	mcf

ELECTRICITY

- 10a. Please complete the following. (if "none" enter zero for units)

	BIL	MIL	THOU	UNITS
(1) Amount of electricity purchased or received in 1979				/ kWh
(2) Total amount of electricity generated onsite in 1979				/ kWh
(3) Amount of electricity sold or transferred offsite in 1979				/ kWh
(4) Electricity used onsite in 1979 [this figure should be the same as (1) + (2) - (3)]				/ kWh

- 10b. Of the total amount of electricity generated onsite in 1979 [the amount reported in 10a (2)] please report the amounts generated by each of the following:

☐ No electricity generated (go to item 11)

	BIL	MIL	THOU	UNITS
(1) Steam				/ kWh
(2) Gas turbines				/ kWh
(3) Internal combustion engines				/ kWh
(4) Hydro				/ kWh
(5) Other (specify)				/ kWh

OTHER ENERGY SOURCES	<p>11. Please report the Btu output from any of the following energy sources used by this establishment in 1979. (do not report any amounts of energy reported in items 8, 9 or 10)</p> <p><input type="checkbox"/> None used in 1979 (go to item 12)</p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th rowspan="2" style="text-align: left;">ENERGY SOURCE</th><th colspan="3" style="text-align: center;">Btu OUTPUT DERIVED FROM SOURCE IN 1979</th><th rowspan="2" style="text-align: right;">Btu</th></tr> <tr> <th style="text-align: center;">MIL</th><th style="text-align: center;">THOU</th><th style="text-align: center;">UNITS</th></tr> </thead> <tbody> <tr> <td>(1) Hydro.....</td><td style="border-bottom: 1px solid black; width: 50px;"></td><td style="border-bottom: 1px solid black; width: 50px;"></td><td style="border-bottom: 1px solid black; width: 50px; text-align: center;">/ / / / /</td><td style="text-align: right;">Btu</td></tr> <tr> <td>(2) Wind</td><td style="border-bottom: 1px solid black;"></td><td style="border-bottom: 1px solid black;"></td><td style="border-bottom: 1px solid black; text-align: center;">/ / / / /</td><td style="text-align: right;">Btu</td></tr> <tr> <td>(3) Geothermal.....</td><td style="border-bottom: 1px solid black;"></td><td style="border-bottom: 1px solid black;"></td><td style="border-bottom: 1px solid black; text-align: center;">/ / / / /</td><td style="text-align: right;">Btu</td></tr> <tr> <td>(4) Solar</td><td style="border-bottom: 1px solid black;"></td><td style="border-bottom: 1px solid black;"></td><td style="border-bottom: 1px solid black; text-align: center;">/ / / / /</td><td style="text-align: right;">Btu</td></tr> <tr> <td>(5) Any other energy sources (specify) _____</td><td style="border-bottom: 1px solid black;"></td><td style="border-bottom: 1px solid black;"></td><td style="border-bottom: 1px solid black; text-align: center;">/ / / / /</td><td style="text-align: right;">Btu</td></tr> </tbody> </table>	ENERGY SOURCE	Btu OUTPUT DERIVED FROM SOURCE IN 1979			Btu	MIL	THOU	UNITS	(1) Hydro.....			/ / / / /	Btu	(2) Wind			/ / / / /	Btu	(3) Geothermal.....			/ / / / /	Btu	(4) Solar			/ / / / /	Btu	(5) Any other energy sources (specify) _____			/ / / / /	Btu																									
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STEAM TRANSFERS	<p>12. Indicate amount of steam transferred into or out of this establishment during 1979. (if none, enter zero)</p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th rowspan="2"></th><th colspan="4" style="text-align: center;">AMOUNT OF STEAM</th><th rowspan="2"></th><th rowspan="2"></th><th rowspan="2" style="text-align: center;">PRESSURE</th><th rowspan="2" style="text-align: center;">TEMPERATURE</th></tr> <tr> <th style="text-align: center;">BIL</th><th style="text-align: center;">MIL</th><th style="text-align: center;">THOU</th><th style="text-align: center;">UNITS</th></tr> </thead> <tbody> <tr> <td>a. Steam purchased or received</td><td style="border-bottom: 1px solid black; width: 50px;"></td><td style="border-bottom: 1px solid black; width: 50px;"></td><td style="border-bottom: 1px solid black; width: 50px;"></td><td style="border-bottom: 1px solid black; width: 50px; text-align: center;">/ / / / /</td><td style="text-align: right;">lb</td><td style="text-align: center;">@</td><td style="border-bottom: 1px solid black; width: 50px;"></td><td style="text-align: right;">°F</td></tr> <tr> <td></td><td style="border-bottom: 1px solid black;"></td><td style="border-bottom: 1px solid black;"></td><td style="border-bottom: 1px solid black;"></td><td style="border-bottom: 1px solid black; text-align: center;">/ / / / /</td><td style="text-align: right;">lb</td><td style="text-align: center;">@</td><td style="border-bottom: 1px solid black;"></td><td style="text-align: right;">°F</td></tr> <tr> <td>b. Steam sold or transferred off site</td><td style="border-bottom: 1px solid black;"></td><td style="border-bottom: 1px solid black;"></td><td style="border-bottom: 1px solid black;"></td><td style="border-bottom: 1px solid black; text-align: center;">/ / / / /</td><td style="text-align: right;">lb</td><td style="text-align: center;">@</td><td style="border-bottom: 1px solid black;"></td><td style="text-align: right;">°F</td></tr> <tr> <td></td><td style="border-bottom: 1px solid black;"></td><td style="border-bottom: 1px solid black;"></td><td style="border-bottom: 1px solid black;"></td><td style="border-bottom: 1px solid black; text-align: center;">/ / / / /</td><td style="text-align: right;">lb</td><td style="text-align: center;">@</td><td style="border-bottom: 1px solid black;"></td><td style="text-align: right;">°F</td></tr> </tbody> </table>		AMOUNT OF STEAM						PRESSURE	TEMPERATURE	BIL	MIL	THOU	UNITS	a. Steam purchased or received				/ / / / /	lb	@		°F					/ / / / /	lb	@		°F	b. Steam sold or transferred off site				/ / / / /	lb	@		°F					/ / / / /	lb	@		°F									
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STEAM GENERATION	<p>13. Indicate amounts of steam generated at this establishment during 1979.</p> <p><input type="checkbox"/> No steam generated (go to item 14)</p> <div style="border: 1px solid black; padding: 5px; width: 200px; margin-bottom: 10px;"> <p>• Include — Steam generated in any boilers, waste heat boilers, or other steam generating units.</p> <p>• Do not include — purchased steam or steam from blow down or condensate.</p> </div> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th rowspan="2"></th><th colspan="4" style="text-align: center;">AMOUNT OF STEAM</th><th rowspan="2"></th><th rowspan="2"></th><th rowspan="2" style="text-align: center;">PRESSURE</th><th rowspan="2" style="text-align: center;">TEMPERATURE</th></tr> <tr> <th style="text-align: center;">BIL</th><th style="text-align: center;">MIL</th><th style="text-align: center;">THOU</th><th style="text-align: center;">UNITS</th></tr> </thead> <tbody> <tr> <td></td><td style="border-bottom: 1px solid black; width: 50px;"></td><td style="border-bottom: 1px solid black; width: 50px;"></td><td style="border-bottom: 1px solid black; width: 50px;"></td><td style="border-bottom: 1px solid black; width: 50px; text-align: center;">/ / / / /</td><td style="text-align: right;">lb</td><td style="text-align: center;">@</td><td style="border-bottom: 1px solid black; width: 50px;"></td><td style="text-align: right;">°F</td></tr> <tr> <td></td><td style="border-bottom: 1px solid black;"></td><td style="border-bottom: 1px solid black;"></td><td style="border-bottom: 1px solid black;"></td><td style="border-bottom: 1px solid black; text-align: center;">/ / / / /</td><td style="text-align: right;">lb</td><td style="text-align: center;">@</td><td style="border-bottom: 1px solid black;"></td><td style="text-align: right;">°F</td></tr> <tr> <td></td><td style="border-bottom: 1px solid black;"></td><td style="border-bottom: 1px solid black;"></td><td style="border-bottom: 1px solid black;"></td><td style="border-bottom: 1px solid black; text-align: center;">/ / / / /</td><td style="text-align: right;">lb</td><td style="text-align: center;">@</td><td style="border-bottom: 1px solid black;"></td><td style="text-align: right;">°F</td></tr> <tr> <td></td><td style="border-bottom: 1px solid black;"></td><td style="border-bottom: 1px solid black;"></td><td style="border-bottom: 1px solid black;"></td><td style="border-bottom: 1px solid black; text-align: center;">/ / / / /</td><td style="text-align: right;">lb</td><td style="text-align: center;">@</td><td style="border-bottom: 1px solid black;"></td><td style="text-align: right;">°F</td></tr> <tr> <td></td><td style="border-bottom: 1px solid black;"></td><td style="border-bottom: 1px solid black;"></td><td style="border-bottom: 1px solid black;"></td><td style="border-bottom: 1px solid black; text-align: center;">/ / / / /</td><td style="text-align: right;">lb</td><td style="text-align: center;">@</td><td style="border-bottom: 1px solid black;"></td><td style="text-align: right;">°F</td></tr> </tbody> </table>		AMOUNT OF STEAM						PRESSURE	TEMPERATURE	BIL	MIL	THOU	UNITS					/ / / / /	lb	@		°F					/ / / / /	lb	@		°F					/ / / / /	lb	@		°F					/ / / / /	lb	@		°F					/ / / / /	lb	@		°F
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OFFICE USE ONLY																																																											

OTHER COMBUSTORS	15. Indicate the current number of all other combustors at this establishment (i.e., combustors not reported in item 14) in each category.																																																																																																																													
	<div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> <ul style="list-style-type: none"> • Do not report combustors with a maximum design firing rate of less than 1 million Btu/hr. • Under "internal combustion engines" do not include self-propelled vehicles; do include equipment such as portable generators with a maximum firing rate of 1 million Btu/hr or greater. </div> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th rowspan="2"></th> <th colspan="6" style="text-align: center;">NUMBER OF OTHER COMBUSTORS</th> <th rowspan="2" style="text-align: center;">For office use only</th> </tr> <tr> <th colspan="6" style="text-align: center;">Maximum Design Firing Rate (in millions of Btu/hr)</th> </tr> <tr> <th></th> <th>1-9</th> <th>10-24</th> <th>25-49</th> <th>50-99</th> <th>100-249</th> <th>250 or greater</th> <th></th> </tr> </thead> <tbody> <tr> <td>Boilers</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Gas turbines</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Internal combustion engines</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Fluid heaters (fired petroleum heater, blast furnace stove, etc.)</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Dryers (mineral dryer, paint dryer, food dryer, etc.)</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Calciners (cement kiln, lime kiln, alumina kiln, etc.)</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Reactors (blast furnace, cupola, reforming furnace, pyrolysis furnace, incinerator, etc.)</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Melters (regenerative glass melter, reverberatory furnace, open hearth furnace, etc.)</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Heat treaters (annealing lehr, brick kiln, tempering furnace, oven, etc.)</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Reheaters (soaking pit, reheat furnace, etc.)</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Sinterers/Pelletizers (vertical shaft furnace, grate kiln, sintering furnace, etc.)</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>For office use only</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table>									NUMBER OF OTHER COMBUSTORS						For office use only	Maximum Design Firing Rate (in millions of Btu/hr)							1-9	10-24	25-49	50-99	100-249	250 or greater		Boilers								Gas turbines								Internal combustion engines								Fluid heaters (fired petroleum heater, blast furnace stove, etc.)								Dryers (mineral dryer, paint dryer, food dryer, etc.)								Calciners (cement kiln, lime kiln, alumina kiln, etc.)								Reactors (blast furnace, cupola, reforming furnace, pyrolysis furnace, incinerator, etc.)								Melters (regenerative glass melter, reverberatory furnace, open hearth furnace, etc.)								Heat treaters (annealing lehr, brick kiln, tempering furnace, oven, etc.)								Reheaters (soaking pit, reheat furnace, etc.)								Sinterers/Pelletizers (vertical shaft furnace, grate kiln, sintering furnace, etc.)								For office use only							
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CONTACT	16. Person to be contacted regarding this report. Name: _____ Title: _____ Telephone No. () _____ Mailing address (if different from mailing label in item 1): _____																																																																																																																													
DISCLOSURE	17. Disclosure Statement a. Does the information supplied on this form contain trade secrets and/or privileged or confidential commercial or financial information? (1) <input type="checkbox"/> No (go to item 18) (2) <input type="checkbox"/> Yes (continue with item 17b)																																																																																																																													
OFFICE USE ONLY	b. Have you attached a written justification for exemption from Freedom of Information Act, 5 USC 552(b)(4)? (see page 1) (1) <input type="checkbox"/> No (2) <input type="checkbox"/> Yes																																																																																																																													
CERTIFICATION	18. Certification (to apply to Section I and all forms which constitute Section II of this report): print the name and title of the individual designated by the company to sign this certification. This individual must sign in the space provided and enter date of signing. This report is substantially accurate and has been prepared in accordance with instructions, and covers the period _____ to _____. <div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> _____ PRINTED NAME </div> <div style="width: 45%;"> _____ TITLE </div> </div> <div style="display: flex; justify-content: space-between; margin-top: 10px;"> <div style="width: 45%;"> _____ SIGNATURE </div> <div style="width: 45%;"> _____ DATE </div> </div>																																																																																																																													

UNITED STATES
DEPARTMENT OF ENERGY
ENERGY INFORMATION ADMINISTRATION



1980 Manufacturing Industries
Energy Consumption Study and
Survey of Large Combustors

FORM APPROVED
OMB NUMBER 038-S80011

ID NO.:

SECTION II – INDIVIDUAL COMBUSTOR REPORT

THIS REPORT IS MANDATORY (see page 4 of Section II, General Instructions)

Assign sequential numbers to each boiler, gas turbine, internal combustion engine and each fired component of a combined cycle unit for which you are reporting. As an example, if you are reporting for four boilers and one combined cycle unit with two fired components the numbers should go from 01 through 06 (01 through 04 would identify individual boilers; 05 and 06 would identify the two components of the combined cycle unit).

IDENTIFICATION

- 1a. Enter the sequential number assigned to this combustor.
1b. Name or identification number assigned to this combustor in your company's records:

2a. Is this combustor part of a combined cycle unit?

- (1) ☐ No (go to item 3) (2) ☐ Yes (continue with item 2b)

2b. Please list the numbers (as assigned in item 1a) of all other fired components of this combined cycle unit.

KIND OF COMBUSTOR

3. What kind of combustor or component of a combined cycle unit is this? (mark one box only)

- (1) ☐ Boiler (continue with items 4a, b, & c) (3) ☐ Internal Combustion Engine (go to item 5)
(2) ☐ Gas Turbine (go to item 5)

BOILER OPERATION

4a. What is this boiler's design (rated) steam/hot water:

- (1) Pressure? psig (2) Temperature? °F

(3) Flow Rate? MIL THOU UNITS lb/hr (steam), or, MIL THOU UNITS Btu/hr (hot water boilers only)

4b. For this boiler, what is the annual average steam/hot water:

- (1) Pressure? psig (2) Temperature? °F

(3) Deaerator pressure? psig, or, Feedwater temperature? °F

4c. Is the steam or hot water produced by this boiler used for: (mark all that apply)

- (1) ☐ Space heating, ventilating, or air conditioning? (3) ☐ Electricity generation?
(2) ☐ Process heat? (4) ☐ Mechanical drive (other than electricity generation)?

(NOW GO TO ITEM 6)

SHAFT POWER

5. Indicate below whether this gas turbine/internal combustion engine is used for electricity generation or mechanical drive (mark one box only). Also indicate the rated output of this unit.

USE

RATED OUTPUT

THOU UNITS

(1) ☐ Electricity generation kW

(2) ☐ Mechanical drive hp

YEAR INSTALLED		YEAR		
FUEL CODES (for office use only)		6. In what year was this combustor initially installed at this establishment? Report year of initial installation regardless of any alterations or modifications since then.		
		YEAR		
COMBUSTOR DESIGN AND FUEL USE		7. In column (1) of the following table, indicate all the fuel(s) that this combustor was initially designed, or has been modified, to use (mark all that apply). Indicate in column (2) the amount of each fuel used in this combustor in 1979.		
		FUEL	DESIGNED OR MODIFIED TO USE (1)	AMOUNT USED IN 1979 (2)
		SOLIDS		MIL THOU UNITS
		(11) Anthracite	<input type="checkbox"/>	____ ____ ton
		(12) Bituminous coal	<input type="checkbox"/>	____ ____ ton
		(13) Lignite	<input type="checkbox"/>	____ ____ ton
		(14) Coke and breeze	<input type="checkbox"/>	____ ____ ton
		(15) Wood, bark, wood waste (50% moisture basis)	<input type="checkbox"/>	____ ____ ton
		Other solid fuels (specify)	<input type="checkbox"/>	____ ____ ton
		_____	<input type="checkbox"/>	____ ____ ton
		LIQUIDS		
		(21) Motor gasoline	<input type="checkbox"/>	____ ____ gal
		(22) Distillate fuel oils (1, 2, 4 & light diesel)	<input type="checkbox"/>	____ ____ gal
		(23) Residual fuel oils (5, 6 & heavy diesel)	<input type="checkbox"/>	____ ____ gal
		(24) Pulping liquor (bone dry basis)	<input type="checkbox"/>	____ ____ ton
		Other liquid fuels (specify)	<input type="checkbox"/>	____ ____ gal
		_____	<input type="checkbox"/>	____ ____ gal
		_____	<input type="checkbox"/>	____ ____ gal
		GASES		
		(31) Natural gas	<input type="checkbox"/>	____ ____ mcf
		(32) LPG, butane, propane	<input type="checkbox"/>	____ ____ gal
		(33) Blast furnace gas	<input type="checkbox"/>	____ ____ mcf
		(34) Coke oven gas	<input type="checkbox"/>	____ ____ mcf
		(35) Refinery off gas	<input type="checkbox"/>	____ ____ mcf
		Other gaseous fuels (specify)	<input type="checkbox"/>	____ ____ mcf
		_____	<input type="checkbox"/>	____ ____ mcf
		_____	<input type="checkbox"/>	____ ____ mcf
		OTHER (specify) _____	<input type="checkbox"/>	____ ____ Btu
		_____	<input type="checkbox"/>	____ ____ Btu

DESIGN SULFUR AND Btu CONTENT	<p>8. If this combustor was either designed, or has been modified, to use a solid fuel, what was the design sulfur and Btu content of that fuel?</p> <div style="display: flex; justify-content: space-between; align-items: flex-end;"> <div> <input type="checkbox"/> Not applicable </div> <div> _____ % Sulfur </div> <div> THOU UNITS _____ Btu/lb </div> </div>																
FIRING RATES	<p>9. What is this combustor's current maximum design firing rate?</p> <div style="display: flex; justify-content: space-between; align-items: flex-end;"> <div>BIL MIL THOU UNITS</div> <div> _____ Btu/hr </div> </div> <p>10. At what firing rate is this combustor operated when it is in use? <i>(indicate both range and usual rate when not banked)</i></p> <div style="display: flex; justify-content: space-between; align-items: flex-end;"> <div>BIL MIL THOU UNITS</div> <div> RANGE: From _____ Btu/hr to _____ Btu/hr </div> </div> <div style="display: flex; justify-content: space-between; align-items: flex-end;"> <div>UNITS</div> <div> USUAL RATE: _____ Btu/hr </div> </div>																
FLUE GAS	<p>11a. Approximately what is the temperature of the flue gas at the exit of this combustor while in use at the usual firing rate? <i>(the rate indicated as usual in item 10)</i></p> <p style="text-align: right;">_____ °F</p> <p>11b. What type of heat recovery equipment is used beyond this exit? <i>(mark all that apply)</i></p> <div style="display: flex; flex-wrap: wrap;"> <div style="width: 33%;">(1) <input type="checkbox"/> None</div> <div style="width: 33%;">(4) <input type="checkbox"/> Economizer</div> <div style="width: 33%;">(7) <input type="checkbox"/> Other <i>(specify)</i> _____</div> <div style="width: 33%;">(2) <input type="checkbox"/> Regenerative air preheater</div> <div style="width: 33%;">(5) <input type="checkbox"/> Waste heat boiler</div> <div style="width: 33%;">(3) <input type="checkbox"/> Recuperative air preheater</div> <div style="width: 33%;">(6) <input type="checkbox"/> Raw material preheater</div> </div>																
COMBUSTOR USAGE	<p>12. If your company did not operate this plant in 1979, or if this combustor was installed after 1979, check box below.</p> <p><input type="checkbox"/> Skip items 13 & 14</p> <p>13. Please estimate the number of hours in 1979 this combustor was in use at approximately the usual firing rate.</p> <p style="text-align: right;">_____ Hours</p> <p>14. During 1979, approximately how many days each month was this combustor not in use? <i>(count only days on which this combustor was shut down for a 24 hour period)</i></p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 25%;">NUMBER OF DAYS</th><th style="width: 25%;">NUMBER OF DAYS</th><th style="width: 25%;">NUMBER OF DAYS</th><th style="width: 25%;">NUMBER OF DAYS</th></tr> </thead> <tbody> <tr> <td>(1) January _____</td><td>(4) April _____</td><td>(7) July _____</td><td>(10) October _____</td></tr> <tr> <td>(2) February _____</td><td>(5) May _____</td><td>(8) August _____</td><td>(11) November _____</td></tr> <tr> <td>(3) March _____</td><td>(6) June _____</td><td>(9) September _____</td><td>(12) December _____</td></tr> </tbody> </table>	NUMBER OF DAYS	NUMBER OF DAYS	NUMBER OF DAYS	NUMBER OF DAYS	(1) January _____	(4) April _____	(7) July _____	(10) October _____	(2) February _____	(5) May _____	(8) August _____	(11) November _____	(3) March _____	(6) June _____	(9) September _____	(12) December _____
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NOTES OR COMMENTS:																	

GENERAL INSTRUCTIONS

This report is mandatory under the Federal Energy Administration Act of 1974, P.L. 93-275, and the Powerplant and Industrial Fuel Use Act of 1978, P.L. 95-620. Failure to respond may result in criminal fines, civil penalties and other sanctions, as provided by law.

The information reported on these forms may be (i) information that is exempt from disclosure to the public under the exemption for trade secrets and confidential commercial information specified in the Freedom of Information Act, 5 USC 552 (b) (4) (FOIA), or (ii) prohibited from public release by 18 USC 1905. However, before the determination can be made that particular information is within the coverage of either of these statutory provisions, the person submitting the information must make a showing, satisfactory to the Department of Energy, concerning its confidential nature.

Therefore, respondents wishing to claim such exemption must state specifically (on an element by element basis, if possible) in a letter accompanying submission of this form, why they consider the information concerned to be a trade secret or other proprietary information, whether such information is customarily treated as confidential information by these companies and the industry, and the type of competitive harm that would result from disclosure of the information. In accordance with the provisions of 10 CFR 1004.11, DOE's Freedom of Information Act Regulations, DOE will determine whether the information submitted should be withheld from public disclosure. If DOE receives the responses and does not receive a request with substantive justification that the information submitted should not be released to the public, DOE may assume that the respondent does not object to disclosure to the public of any information submitted by it on the forms.

The provisions of Section 711(a) of P.L. 95-620, the Powerplant and Industrial Fuel Use Act of 1978, which incorporate by reference the provisions of Section 11 (d) of P.L. 93-319, the Energy Supply and Environmental Coordination Act of 1974, apply to the information submitted on this form. Upon request, therefore, DOE must provide information obtained on this form to the Attorney General, the Secretary of the Interior, and the Federal Trade Commission in accordance with the cited statutes and other applicable authority. The information must also be made available upon request to the Congress or any committee of the Congress and to the General Accounting Office.

1. Complete a separate copy of Section II for:

- each boiler, gas turbine, and internal combustion engine with a maximum design firing rate of 50 million Btu/hr or greater, and
- each *fired component* of a combined cycle unit in which the components total a firing rate of 50 million Btu/hr or greater.

2. Fill out a copy of Section II for each combustor of the specified maximum firing rate, even if the combustor was unused in 1979, unless the combustor was permanently destroyed or removed from the site prior to 1979.

3. All items which ask for figures for "1979" refer to the 12 months of *calendar year 1979*. If your establishment maintains its records on a fiscal year basis and the fiscal year ended between September 30, 1979 and March 31, 1980, you may use records from the fiscal year.

4. If records are not available for an item, carefully derived estimates are acceptable.

5. The Glossary explains key terms used in the forms.

6. If the space allowed for your answers is insufficient, use extra sheets of paper to record additional pertinent information. Be sure to identify the question number for each item reported on the extra sheets.

7. For additional copies of the forms write or call:

Mr. Stephen J. Dienstfrey, Industrial Survey Manager
U.S. Department of Energy
P.O. Box 2100
Rockville, MD 20852
800-638-6584

or you may duplicate as many copies of the forms as needed. If you make duplicate copies, please be sure that the printed ID number which appears on page 1 is clearly legible on all reproduced copies.

8. If you wish to amend or correct any items after returning your completed forms, send the corrections to Mr. Dienstfrey at the address above. Clearly identify the item(s) to be amended or corrected.

GLOSSARY

Anthracite — ASTM class I coal.

Bituminous Coal — ASTM classes II and III coal. Please note that sub-bituminous coal should be reported under this category.

Boiler — A unit which heats water for the generation of steam and/or hot water.

Bone Dry — 0% moisture.

Calciner — A combustor which heats solid material to a high temperature without fusing. Its principal function is to decompose hydrates, carbonates, and other compounds and expel volatile matter. This will primarily refer to the heating of unformed materials in a kiln such as a rotary cement kiln, lime kiln, or alumina kiln.

Coke — The solid residue remaining from the destructive distillation of coal or other carbonaceous material such as pitch, petroleum, or petroleum residue. Coke which is used as a raw material in a blast furnace, cupola furnace or any other operation should not be reported as a fuel in this survey.

Combined Cycle Unit — An electric or mechanical power generating unit that consists of a combination of one or more combustion turbine units and one or more boilers with a substantial portion of the required energy input to the boiler(s) provided by the exhaust gas of the combustion turbine unit(s). Use of supplemental firing for the boiler does not preclude the unit from being designated a combined cycle unit.

Combustor — A unit which consumes fuels that are used primarily to provide heat. Examples are boilers, furnaces, ovens, combustion turbines, blast furnaces, internal combustion engines, and combined cycle units.

Dryer — A combustor which drives off or removes water or other volatile compounds from the material being processed. Typical types of dryers would be rotary mineral dryers, shaft mineral dryers, paint drying ovens, or food dryers.

Establishment — The definition of establishment for this survey is the same as that used by the Bureau of Census; in general, that is a single physical location where manufacturing is performed.

Feedstocks — Materials (which can also be used as fuels) which are consumed as raw materials in the production of intermediate or finished products. Feedstocks do not include materials used primarily for process heat. Coal used for coking, crude oil that is refined, and coke used in blast furnaces, are all considered feedstocks for this survey.

Firing Rate — Fuel heat input rate. The rate at which fuel is supplied to a combustor. The firing rate calculation is based on the higher heating value of the fuel.

Fluid heater — A combustor that heats (or preheats) gases or liquids. Examples of fluid heaters are fired petroleum heaters and blast furnace stoves. Combustors where a chemical reaction takes place simultaneously with heating are considered reactors, not heaters.

Gas Turbine — A heat engine that converts energy of fuel into work by using compressed hot gas as the working medium. Usually delivers its mechanical output through a rotating shaft. Also known as a combustion turbine.

Heat Treater — A combustor that heats a material to create or remove specific properties in the material. Heat treating is particularly widespread in the metals industries. Examples of heat treaters are glass annealing lehrs and brick kilns.

Higher Heating Value — The total heat obtained from the combustion of a specified amount of fuel and the stoichiometrically correct amount of air, both at 60° F when combustion starts, and the combustion products being cooled to 60° F before the heat release is measured. This is the heating value that is typically reported in the United States.

Hot Water Boiler — A boiler that can produce only hot water and not steam.

Internal Combustion Engine — A prime mover in which the fuel is burned within the engine and the products of combustion serve as the working medium.

Lignite — ASTM class IV coal.

GLOSSARY (CONTINUED)

Maximum Design Firing Rate — The maximum firing rate that the combustor is designed to achieve over a period of continuous operation.

mcf — One thousand cubic feet at 14.73 psia and 60°F.

Melter — A combustor where the principal function is the conversion of a solid to a liquid at high temperature. Examples include glass melters, aluminum reverberatory melters and open hearth furnaces.

Metallurgical Coal — Bituminous or coking coals which are used to produce coke for blast furnaces and cupola furnaces.

Onsite — Pertains to operations which are performed on the grounds of the establishment itself.

Reactor — A combustor in which a chemical reaction takes place. Examples include reforming furnaces or pyrolysis furnaces in the chemical industry, or blast furnaces or coke ovens in the steel industry.

Recuperative Air Preheater — A continuous heat exchanger where heat passes through a surface separating the exiting flue gases, which are being cooled, and the material being heated, usually incoming combustion air.

Regenerative Air Preheater — A cyclical heat exchanger where the exiting flue gases give up heat as they pass over exchanger internals. This heat is released to the material being heated, usually incoming combustion air, as it passes over the exchanger internals in the opposite part of the cycle (includes heat wheels).

Reheater — A combustor where the primary function is to bring the temperature of a solid material to a level appropriate for subsequent operations. Examples include steel reheating furnaces and soaking pits.

Sinterer/Pelletizer — A combustor which agglomerates ores, coke breeze, or metal powders without melting.

Usual Rate — The most typical or frequent rate of operation.

CONVERSION FACTORS

MULTIPLY	BY	TO OBTAIN
Barrels	42.0	Gallons
Btu	0.000393	Horsepower-hour
Btu	0.000293	kWh
Btu/hr	0.000393	Horsepower
Btu/hr	0.000293	Kilowatt
Horsepower	2545.0	Btu/hr
Horsepower	0.7457	Kilowatt
Horsepower-hour	2545.0	Btu
Kilowatt	3412.0	Btu/hr
Kilowatt	1.34	Horsepower
Kilowatt-hour	3412.0	Btu

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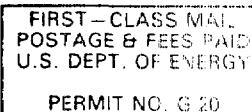
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